Internship MII: Conception of Bragg mirror and active optical microcavity by spin-coating of nanocomposites layers

Scientific context :

Bragg mirrors are periodic structures composed of alternating layers of materials with different refractive indices. These structures selectively reflect specific wavelengths of light with high efficiency due to constructive interference. They form the building blocks of **optical microcavities, resonators** capable of confining light in extremely small volumes. This confinement enhances light-matter interactions, which is essential for applications in lasers, sensors, and quantum technologies. Traditionally, these structures are fabricated using vacuum deposition methods, which are time-consuming and energy-intensive. Our team has recently proved that an SU8/ZrO_2 nanocomposite multilayer can be used to create Bragg mirrors in the IR range **[1]**. This internship offers an opportunity to explore this approach to achieve optical mirrors in the visible range, targeting especially the green and red wavelengths region (532 nm and 633 nm). In a second step, a light emitter (molecule or nanoparticle) will be placed either near the mirror or at the center of a spin-coated microcavity to investigate fundamental physical phenomena, such as the Purcell effect and the strong-coupling regime.

Internship objectives:

At first, the student will rely on the laboratory's expertise to **formulate multilayers of functional resins** suitable for spin coating (**Fig1(A)**). Then, he will **size, manufacture and characterize the Bragg mirrors** in the visible range by optical spectroscopy resolved in polarization and in incident angle (**Fig1(B)**). A statistical study on the impact of the layer thickness error on the optical response of the mirrors will be considered. Finally, he will attempt to integrate a microcavity within two dielectric mirrors containing light emitters adapted to the resonance of the component ((**Fig1(C)**).

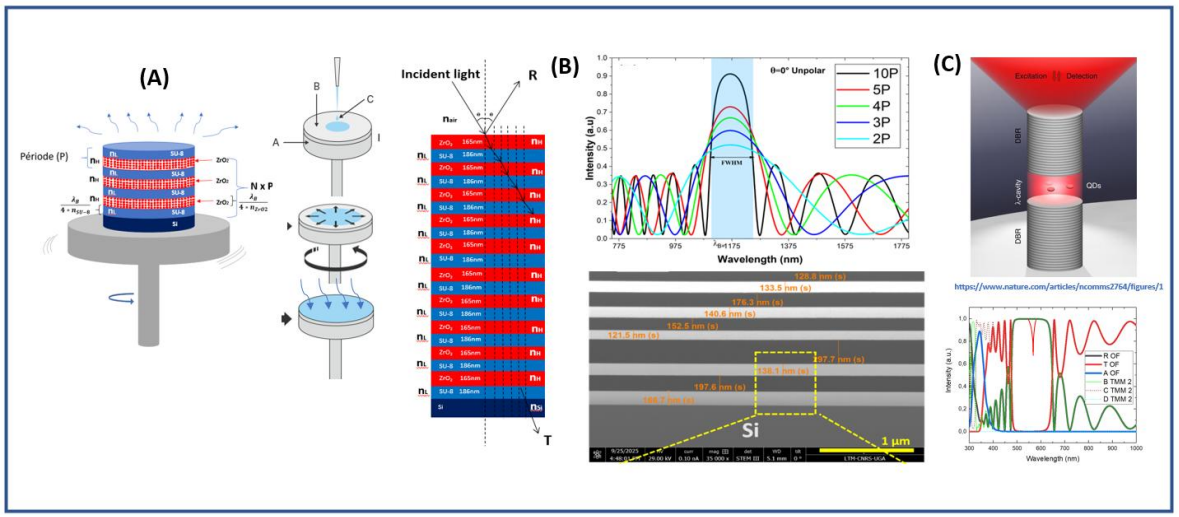


Figure 1. (A) Schematic of spin-coating method Bragg mirror **(B)** Optical response model of a Bragg Mirror (TMM) and FIB cross-section of a multilayer stack SU8/ZrO_2. **(C)** 1D Optical active microcavity

Profil: We are looking for a Master 2 student in nanophysics or physics, with a strong interest in: optical modeling (numerical methods, Python), experimentation in microfabrication (spin-coating, optical characterization) and nanotechnologies applied to photonics.

Host laboratory :

The internship will be carried out mainly at the Microelectronics Technologies Laboratory (LTM): located on the CEA-LETI-MINATEC site.

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Internship Allowance: Yes

Possibility of PhD Continuation: Yes, subject to success in the EEATS Doctoral School

[1] M. Chag et al. Spin-coating of IR Bragg Mirror based on ZrO2 nanocomposite **MNE 2026** *to be submit to Microelectron. Eng.*